

# Learning from Demonstration Projects in Sustainable Energy and Transport

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# LEARNING FROM DEMONSTRATION PROJECTS IN SUSTAINABLE ENERGY AND TRANSPORT

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**SPECIAL TRACK 3: CHANGING INNOVATION POLICY AND GOVERNANCE FOR SUSTAINABILITY**

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## EXTENDED ABSTRACT

Governmental supported demonstration and trail projects have over more than a century played a central role in the development and dissemination of energy technologies. A well-documented early example from Denmark is Poul la Cour's facility for wind turbines started in the 1890's, that comprised both a experiments with the technology, demonstration of its practical feasibility and also has a strong component of training of practitioners and dissemination of the technology leading to a relative widespread use of electricity producing wind turbines in Denmark two decades later (Arnfred, 1964). The importance of demonstration of the technology also paved the way for the Danish test station for renewable energy technologies (e.g. wind turbines) in the late 1970s and the launch of the Danish development and demonstration programme for renewable energy in the same period.

Also more recently there is a growing interest within both academia and policy in the role of trail and demonstration project in relation to innovation policy and in relation to transitions to sustainable energy and transport. As an indication of the increased interest from policy makers in the role of demonstration projects the governmental expenditures on demonstration projects was in 2003 been added to the original Frascati Manual typology of the IEA/OECD's data collection on R&D indicators. Data from this database shows increased governmental expenditures on 'demonstration'. A similar conclusion is drawn in a recently concluded Scandinavian project (Andersen et al, 2014). Academic research has analysed the experiences of American, European and Japanese demonstration and trial projects for solar photovoltaic and wind technologies (Brown & Hendry, 2009; Harborne & Hendry, 2009; Hendry & Harborne, 2011; Hendry, Harborne, & Brown, 2010).

The reason for this increased interest can be found in the observation that demonstration projects can be seen as attempts "*to shorten the time within which a specific technology makes its way from development and prototype to widespread availability and adoption by industrial and commercial users*" (Lefevre, 1984). As noted by Wene (2000, p28) "*A system that has no output will not learn, meaning, that a technology which is not produced and deployed cannot start ride down the experience curve. Technologies cannot become cost-efficient by laboratory R&D alone*". Market-wide commercialisation and diffusion of a new

technology occur after the technology has been successfully tested in large-scale demonstration projects and user feedback has been incorporated.

Ever since the works of Joseph Schumpeter academia has tried to understand the complex processes for development and diffusion of new technologies. This paper takes a theoretical departure from the innovation systems approach that first emerged as a national innovation system that was concerned with building a national knowledge infrastructure for economic development (Freeman, 1987; Lundvall, 1992; Nelson & Rosenberg, 1993). The framework has developed in different directions that include different levels and dimensions, such as technology-specific innovation systems (Bergek, Hekkert, & Jacobsson, 2008; Carlsson & Stankiewitz, 1995).

The innovation systems approach focuses on the flow of information and knowledge between actors, in contrast to other analytical approaches that focus on the flow of money or goods. As stated by Freeman, '*Numerous case studies of innovation brought out the importance of flows of information and knowledge between firms as well as within firms. Moreover, the results of the empirical research pointed to the importance both of flows to and from sources of scientific and technical knowledge and of flows to and from users of products and processes*' (Freeman, 1996). Hence, the importance of learning from the user–producer interaction is emphasised. This also includes the interactions of the knowledge producers and users. Another core element in the innovation systems approach is that learning is the most central activity in an innovation system, and that learning is mainly interactive (Johnson, 1992). The explicit introduction of interactive learning to innovation studies came in the form of user–producer interactions (Lundvall, 1985). Lundvall argues that innovation emerges from confronting user needs with technological opportunities. This raises a challenge for new technologies with a limited market presence and, consequently, few opportunities for user-producer interactions. Furthermore, demonstration projects have been defined as a decisive phase of the development of new technologies, designed to promote various forms of learning (Raven 2005). This is among the key rationales for governmental support for demonstration and trail projects. Based on the concept of the technological innovation system (Carlsson & Stankiewicz 1991) Hellmark (2011) identifies a number if roles for demonstration projects including the formation of knowledge networks and facilitating learning.

This leads to the research problem behind this paper. There exists a very large literature and conceptual development on learning's role innovation and in innovation systems. This comprises concepts such as learning-by-doing, learning-by-using, learning-by-searching, learning by interacting, policy learning etc. The paper will contain a brief overview of this literature. Also there is a large literature on demonstration and trail projects in sustainable energy and transport. However there is only few empirical studies of the learning from demonstration and trail projects in sustainable energy and transport, the studies carried out at Cass Business School being one of the exceptions (Brown & Hendry, 2009; Harborne & Hendry, 2009; Hendry & Harborne, 2011; Hendry, Harborne, & Brown, 2010). This paper aims to contribute to this research gab with solid empirical foundation. The overall research question of the paper is: Can the empirical

data on learning from demonstration and trail projects in sustainable energy and transport confirm what conceptual studies suggest? The paper will focus on a range of more detailed questions, e,g,:

- What types of learning (using, doing, interacting, policy learning, etc.) appears in the projects
- Are there any differences between planned leaning and the realised learning in the projects.
- Which types of actors are learning throughout the projects?

**Empirical data**

The paper reports from a part of the project Role of demonstration projects in innovation: transition to sustainable energy and transport (InnoDemo) funded by the Research Council of Norway. This project aimed at providing insights on the roles that trial and demonstration projects and programmes can play in innovation systems with a focus on the domain of sustainable transport and energy in Denmark, Norway and Sweden. The paper is based on three sources of empirical data. First, through a desk-study and explorative interview with programme officials in the three counties, a total of 433 demonstration projects started in the period 2002-2012 was identified across Denmark (224 projects), Norway (107 projects) and Sweden (102 projects). 97 (22%) of these projects were concerned with transportation. Second, an online survey was mailed to 370 project leaders of which 80 responded (a response rate of 22%). Among the questions in the survey were specific questions on learning. Third, 26 in-depth interviews were carried out with project managers and project participants. A large part pf the interviews focussed learning processes during the projects. The in-depth interviews covered 17 projects out of the 433 projects. Together, this gives a unique empirical material for our research. The data behind the analysis of Cass Business School comprised projects in Europe, Japan and USA within wind power, solar photovoltaics and fuel cells from the 1970s to today. Our data comprise a comparable number of projects, but over a wider range of technologies, over a shorter period (10 years), and in fewer countries (3).

**Expected results**

The paper reflects a work in progress. Even though the InnoDemo project is finalised and all empirical data exists the analyses of these data are not yet finalised. However, the paper intent to present the analyses in relation of the research question for this part of the project. Among the preliminary findings is that learning in the projects most frequent related to technical feasibility, appearing in 58% of all projects. Other frequent areas of learning was related to reducing building, operating and maintenance cost (33%); prove feasibility in commercial applications (33%) and facilitate learning (31%). Another outcome of the preliminary analysis is a variation in the objectives across the countries. Objectives related to cost reduction (building, operating and maintenance cost) were relatively frequent in Danish projects but less frequent Swedish. Whereas, objectives related to facilitate learning were less frequent in Danish projects but the second most frequent (57%) objective in the Swedish projects. The final paper will conclude on the implications for innovation policy and suggest issues for future research.

## REFERENCES


Andersen, P. D.; Cramer-Petersen, C. L.; Harnes, K. N.; Klitkou, A.; Nikoleris, A. (2014) Inventory of demonstration and trail projects in sustainable energy and transport in Scandinavia, (ISBN: 978-87-93130-12-8), pages: 31

Arnfred, J. T. (1964), Developments and potential improvements in wind power utilization, In: Proceedings of the United Nations Conference on new sources of energy, Rome 21-31, 1961, Vol 7. United Nations, New York.

Bergek, A., Hekkert, M., & Jacobsson, S. (2008). Functions in innovation systems: A framework for analysing energy system dynamics and identifying goals for system-building activities by entrepreneurs and policy makers. In T. J. Foxon, J. Köhler, C. Oughton: Innovation for a low carbon economy: Economic, institutional and management approaches. Edward Elgar.

Brown, J., & Hendry, C. (2009). Public demonstration projects and field trials: Accelerating commercialisation of sustainable technology in solar photovoltaics. Energy Policy, 37(7), 2560-2573.

Carlsson, B. & Stankiewicz, R. (1991) On the Nature, Function and Composition of Technological systems Journal of Evolutionary Economics 1(2) 93-118.

Hellsmark, H. R. A. (2011). Unfolding the formative phase of gasified biomass in the European Union: The role of system builders in realising the potential of second-generation transportation fuels from biomass. Chalmers University of Technology, Göteborg.

Freeman, C. (1987). Technology policy and economic performance: Lessons from Japan. London: Pinter.

Freeman, C. (1996). The greening of technology and models of innovation. Technological Forecasting and Social Change, 53(1), 27–39.

Hendry, C., Harborne, P., & Brown, J. (2010). So what do innovating companies really get from publicly funded demonstration projects and trials? innovation lessons from solar photovoltaics and wind. Energy Policy, 38(8), 4507-4519.

Hendry, C., & Harborne, P. (2011). Changing the view of wind power development: More than "bricolage". Research Policy, 40(5), 778-789.

Johnson, B. (1992). Institutional learning. In B. A. Lundvall (Ed.), National systems of innovation – Toward a theory of innovation and interactive learning. London: Pinter.

Lefevre, S. R. (1984). Using demonstration projects to advance innovation in energy. Public Administration Review, 44(6), 483-490.

Lundvall, B.-Å., (Ed.), (1992) National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning, London: Pinter Publishers.

Nelson, R., & Rosenberg, N. (1993). Technical Innovation and National Systems. In R. R. Nelson (Ed.), National innovation systems – A comparative analysis. Oxford University Press.

Raven, R. (2005). Strategic Niche Management for Biomass: a comparative study on the experimental introduction of bioenergy technologies in the Netherlands and Denmark. PhD thesis. Technische Universiteit Eindhoven, Eindhoven.

Wene, C.O. (2000) Experience Curves for Energy Technology Policy, OECD/IEA, Paris.